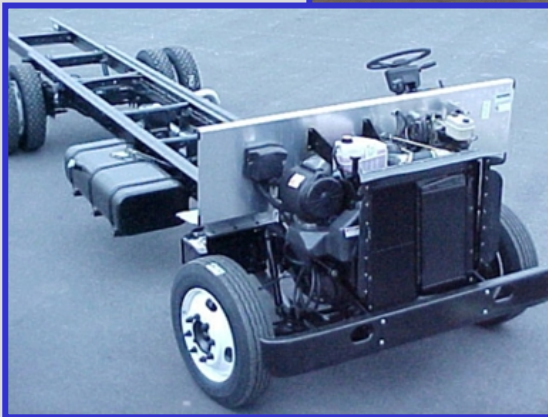




# Illinois Clean Cities Forum

May 2, 2006

## International's Hybrid Program



**Jim Williams**

Director Sales & Distribution New Products  
International Truck and Engine, Corp.





## HTUF Program Objectives

- **Accelerate Commercial Deployment of HEV Technology**
- **Leverage HEV Technology Developed Under the DOE Contract**
- **Establish Fuel Economy, Emission Reduction, Reliability, Durability, Reparability, and Maintainability Standards for Hybrid Electric Vehicles**
- **Deliver up to 24 Development Vehicles to 14 Utilities In North America**



# HTUF Hybrid Program

**Faster to Field – Data Will Also Assist Army Hybrid Decisions**



HTUF Utility Hybrid Work



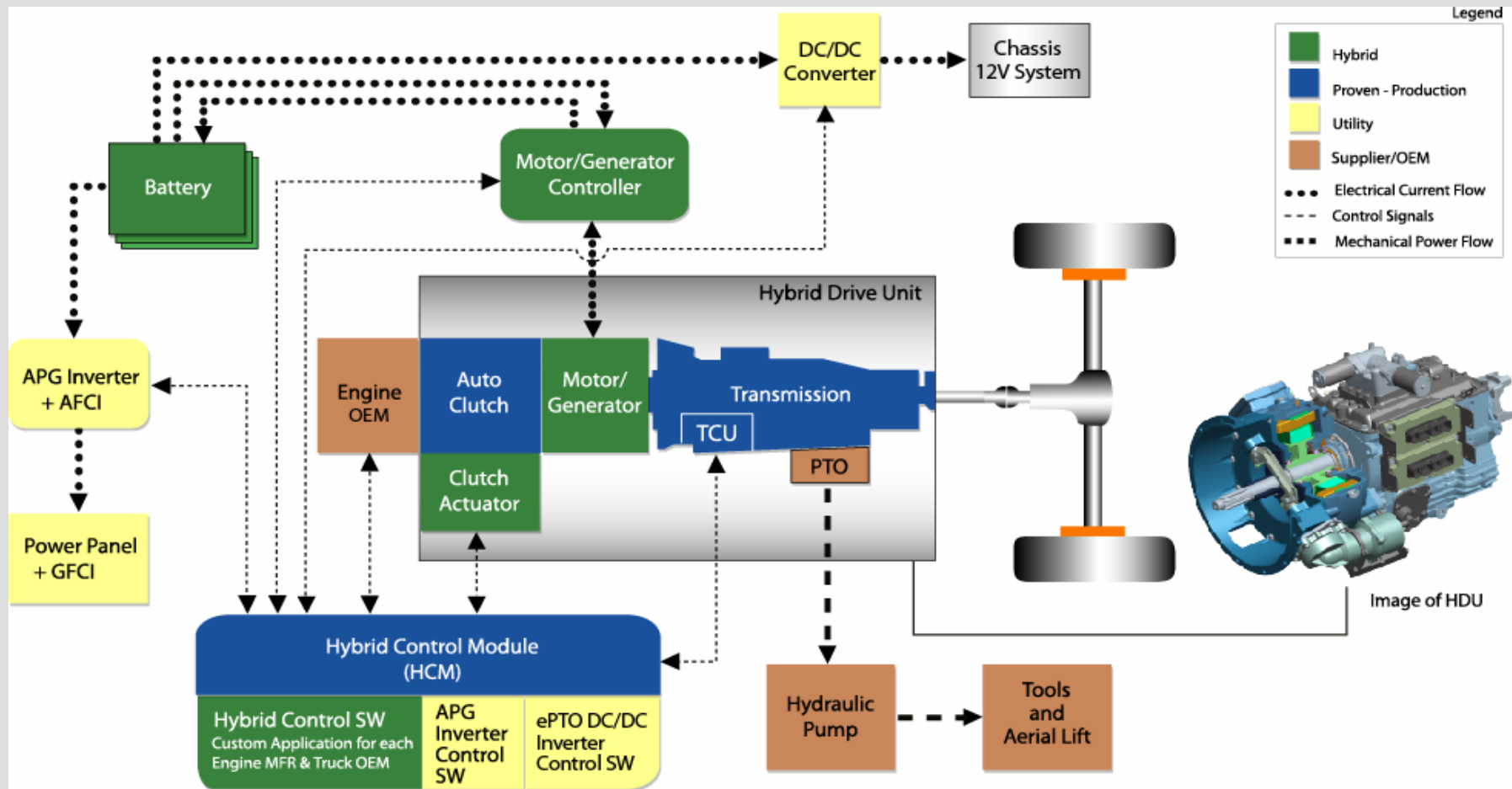


# HTUF Hybrid Program

## Performance Targets

- Equal to or better than conventional powertrain
- Improved startability and gradeability
- Competitive shift quality
- Equal to or better noise, vibration and harshness
- Equal to or better reliability, serviceability, and reparability
- Durability of 350,000-mile vehicle and I-6 engine life
- No more than 500# additional weight
- 1-2 hours “engine off” bucket use with 6-8 minute recharge
- 40% – 60% improved fuel economy – bucket truck
- Up to 20 – 25 KW Clean Power







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# Utility (Validator) Truck

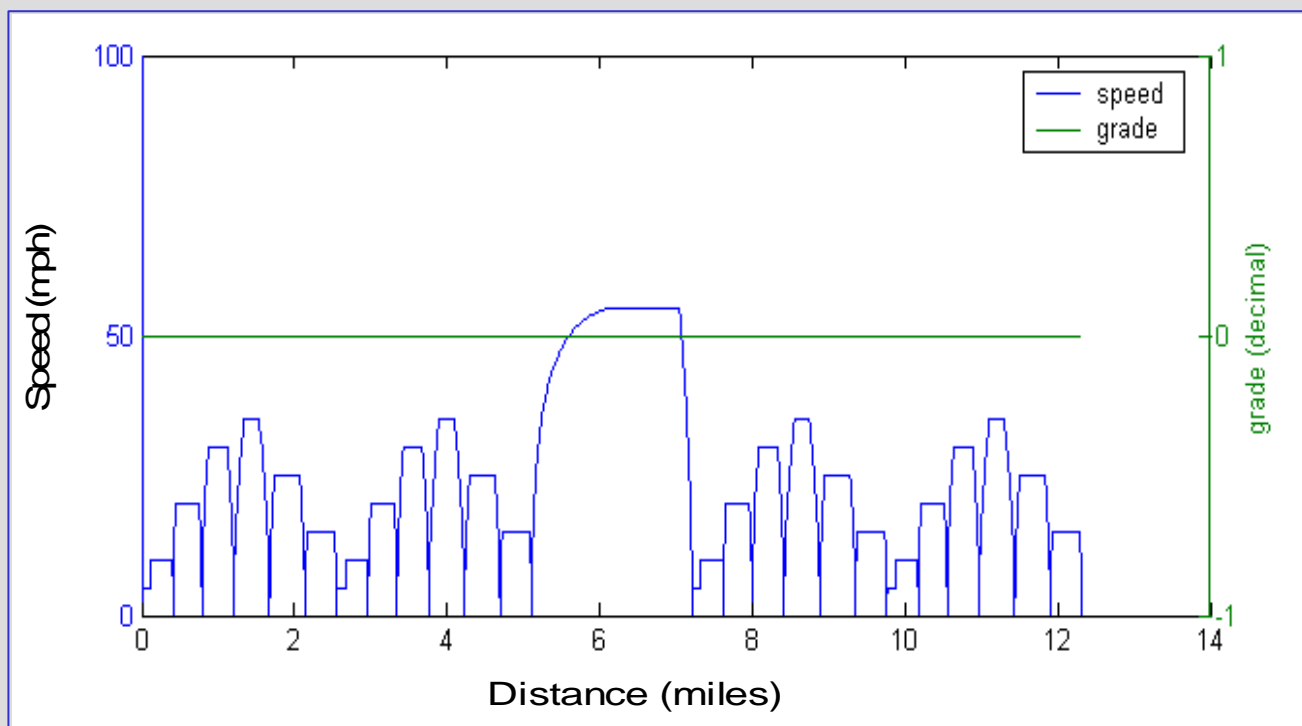
- 4300 Chassis, Altec L42M Body
- **DT466 215HP, 560 lb-ft Engine**
- **44KW Electric Motor**
- **340V, 50kW Li-Ion Battery (4)**
- **Engine On/Off PTO Capable**
- **Auxiliary Power Generation**
- **Telematics Added for Vehicle Performance Monitoring**





# Driving Cycle Modeled

- Developed by Eaton and International to represent work truck driving patterns
- Used for driving portion of HTUF test





## Hybrid Testing Complete

- Tested the validator hybrid truck against similar baseline truck over representative utility truck duty cycles
- Baseline truck 2004 International 4300 with 215 hp engine, Allison automatic transmission
- Tested on chassis dynamometer for driving portion of duty cycle and stationary in work portion
- **Overall results are better than expected for duty cycle results**

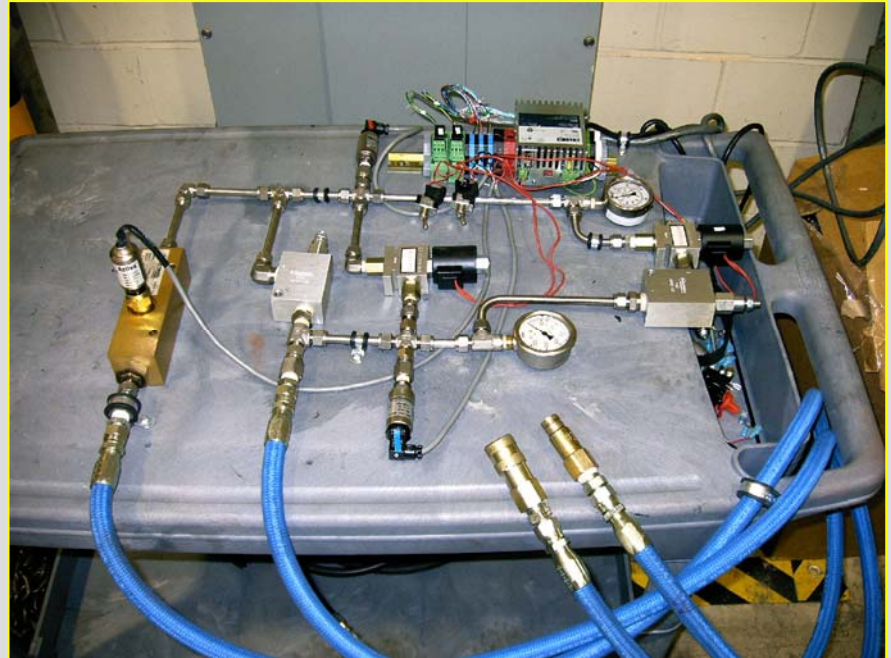






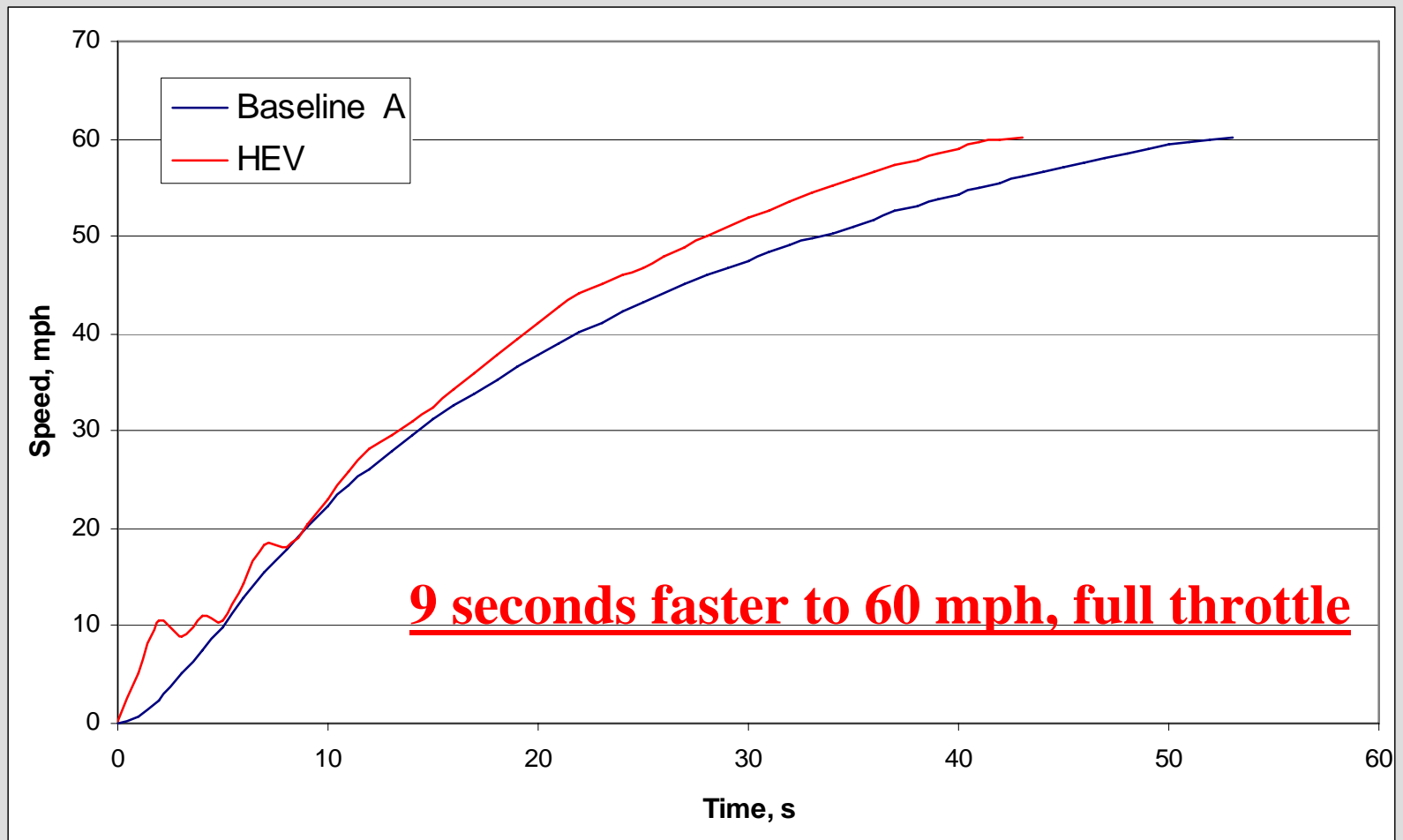
## Work Site Testing

- For work site testing applied a load to the hydraulic pump and tool circuit representing field actions (raising boom, tool work)
- Used external device to apply load to guarantee repeatability of test





## Acceleration 0-60





# HTUF Customer Feedback

<u>Average Ratings (From 27 Respondents):</u>	Average Rating
I found the acceleration of the hybrid truck to be ...	3.7
From a standstill, the initial launch quality was...	3.8
I found the shift quality of the transmission to be...	3.4
The overall braking behavior was...	4.0
The inching/slow speed maneuverability of the hybrid truck was...	4.3
The "grade pulling" ability of the hybrid truck was...	3.7
The overall drivability of the hybrid truck was...	4.0
The overall interior noise level of the powertrain was...	4.4

**Key: 1 = Worse Than, 3 = Same As, 5 = Better Than**

Ratings are for the Hybrid Utility Unit vs. what the customer typically uses.

## **Representative Survey Comments:**

"May take a little driver training (initial) - but should be no problem."

"Getting used to the transmission shift will be the biggest change for normal automatic drivers. Overall - great machine!"

"Very simple - easy to use."



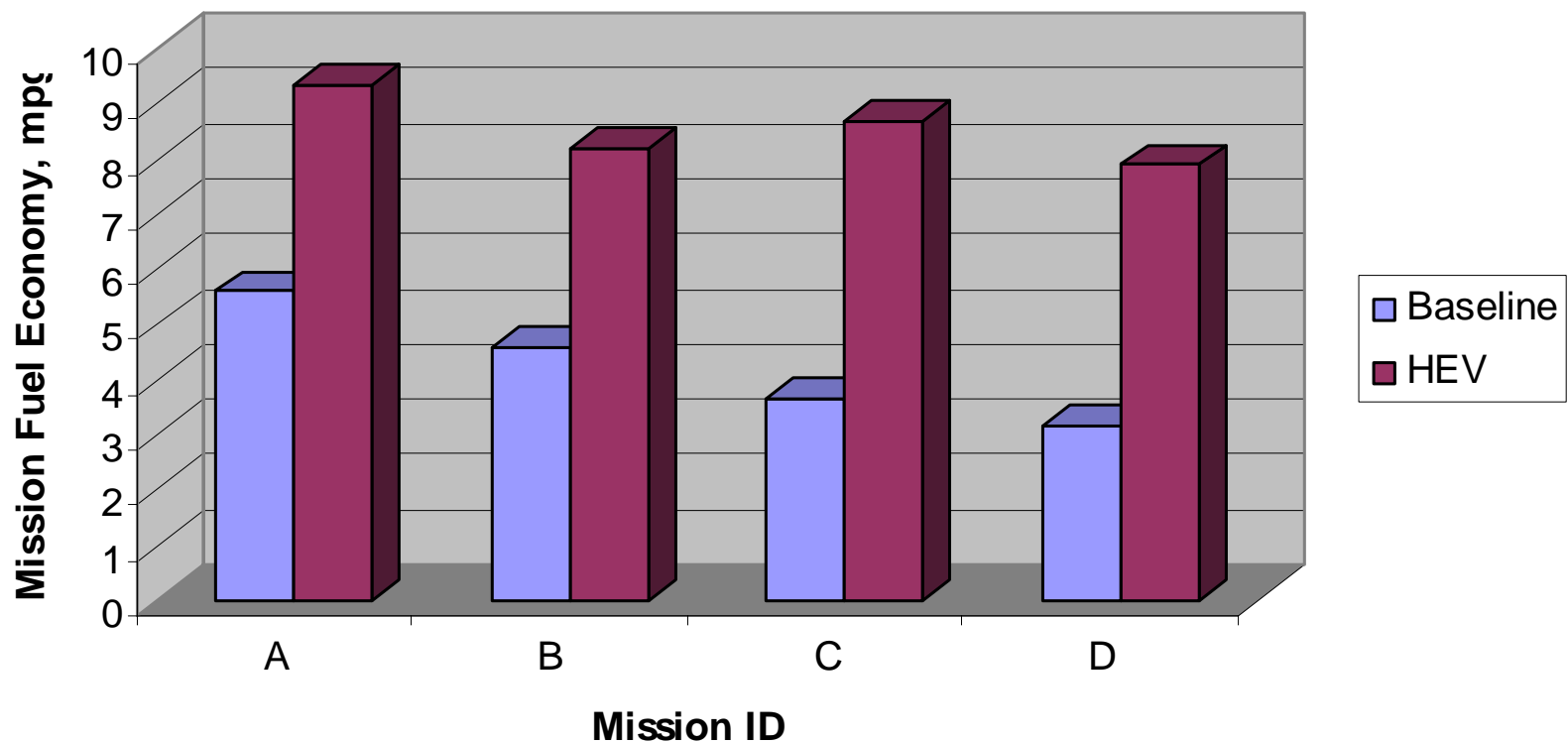
## Fuel Economy (MPG) By Mission

67%

62%

137%

150%







## Fuel Reduction

- Mission A – **40%** reduction in fuel use
- Mission B – **38%** reduction in fuel use
- Mission C – **58%** reduction in fuel use
- Mission D – **60%** reduction in fuel use



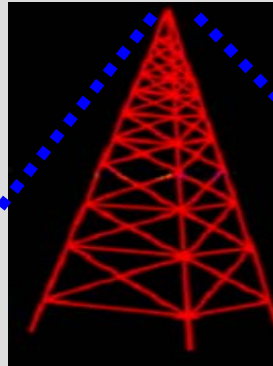


# What Does It Mean In \$\$\$\$\$\$?

- Trouble Truck “Duty Cycle” Model
  - ❖ 3 stops @ 1 ½ hour per stop and 70 mile drive for an 8 hr. day
    - 40% consumption reduction in fuel
    - At \$2.70/gal. Predicted annual fuel savings of \$3,500
- Crew Truck (Severe) “Duty Cycle” Model
  - ❖ 2 stops @ 3 hours per stop and 38 mile drive for an 8 hr. day
    - 60% consumption reduction in fuel
    - At \$2.70/gal. Predicted annual fuel savings of \$4,500
- Substantial Reduction In Emissions
  - ❖ How Do You Measure?



# International Aware™ System



Wireless  
Communications: CDMA  
1xRTT (Verizon)



In-Vehicle  
Device



Combined GPS  
& Cellular  
Antenna



Real-time location,  
performance,  
maintenance and  
diagnostic information



# HEV Utility Vehicle Benefits

## ➤ Noise

- Driving: Potential for Quieter Launches
- Jobsite: Significant Engine Off Time

## ➤ Drivability

- Equal to or Better Drivability

## ➤ Engine Downsizing

- Future Potential to Downsize Engine and Electrify Accessories

## ➤ Auxiliary Power Generation

- 25 KW Exportable Power Available





# HEV Utility Vehicle Benefits

## ➤ Fuel Economy (Driving & Jobsite)

- Driving: Regen. Braking
- Jobsite: Significant Reduced Engine Idling
- Significant Gain To Baseline
  - 2/3 Benefit from Jobsite
  - 1/3 from Driving

## ➤ Emissions

- Less Fuel Consumed, Less Emissions Produced
- Jobsite: Engine “Off” Operation



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# How Far Have We Traveled?



May 2006